

Impact of Project-Based Learning Strategy on Academic Performance of Secondary School Students in Ecology in Bauchi State

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ABSTRACT

The study determined the Impact of Project-Based Learning on the Academic Performance and Attitude of SSII Students in Ecology. The Research Design employed was pretest- posttest Quasi-experimental. One research question and one null hypothesis guided the study. The population for the study was all the 1421 Senior Science Secondary School II Students in all the Senior Secondary Schools within Misau Metropolis of Misau Local Government Area, Bauchi State. Two Schools were randomly selected and one intact class from each of the sampled schools were selected using balloting method to form a sample size of 91. The instrument for data collection was Ecology Performance Test (EPT) developed by the researchers. The instrument was validated by experts after which it was subjected to reliability test using test-retest method. The data was analyzed using Pearson Product Moment Correlation Coefficient and the reliability obtained was, $r = 0.73$. The experimental group was taught Ecology using Project-Based Learning while the control group was taught using Lecture Method. The data collected was analyzed using Mean and Standard Deviation to answer the research question while independent sample t-test was used to test the null hypothesis at 0.05 alpha level. The finding revealed that, students taught ecology using Project-Based Learning performed significantly higher than their counterparts taught through lecture method. Based on the finding of the study, it was recommended among others that the biology teachers should use Project-Based Learning teaching in ecology at secondary school level.

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INTRODUCTION

Teaching and Learning of science is very important for the development of a nation. According to Ngwu, Barnabas and Emmadiole (2019) the teaching and learning of science at secondary school level requires teachers to put more efforts to effectively teach scientific concepts for meaningful learning among the students. The science subjects taught at the Senior Secondary Schools includes; Biology and it forms the basis to study Biology related courses in higher institutions of learning (Jibrin, 2014). Therefore, the teachers'

choice and use of relevant teaching and learning strategies and experience would provide basis for acquisition of sound Biological concepts (Jibrin, Mohammed & Zayum, 2020). This would make the learners to explore their talents and abilities in practicing science in general (David, 2018). The achievement of this will hopefully be fulfilled by employing teaching and learning strategies that are activity orientated-based such as Cooperative teaching strategy, Problem-solving, Peer tutoring, Practical teaching strategy, Project-based teaching strategy among others (FME, 2013).

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Jibrin, Mohammed and Zayum (2020) expressed that these innovative teaching strategies impact positively on students' learning, as against teacher-centred such as the traditional lecture method.

Despite the relevance of Biology to societal development, the learning of the subject at the Senior Secondary School is not appealing and hence affect students' academic performance at the final year school examinations certificate (Bature, Bill & David, 2016; WAEC, 2021). It be could that, most Biology teachers emphasize on theory without carrying out any activities in their teaching processes, hence resulting to inability of students to learn meaningfully (Mohammed, 2012; Jibrin, 2014). Consequently, this makes students not to have clear understanding of some abstract concepts such as genetics, classification of living organisms and ecology among others as revealed by the Chief Examiners' reports of West Africa Examinations Council, (WAEC, 2020 & 2021; Jibrin, Abba and Mohammed (2021). Hence, Babayemi and Kareem (2018) have earlier stated that, the use of any other method other than the child-centred approach would deprived the learners to be involved in hands-on activities, which is critical in learning of concepts in Biology such as ecology.

Ecology is among the topics in the senior secondary school Biology curriculum with includes subunits like; ecosystem, components and size, measuring instruments, functioning ecosystem, food webs and trophic levels, energy flow and impacts of some different factors on an ecosystem. According to Jibrin, Babalola and Isaac (2019) the study of ecology would enable the students to understand the environment and its components, the relationship and interactions between the components of the ecosystem. Despite these, most students perceived the concept abstract thereby exhibiting shallow knowledge of ecological concepts. This is indicated in way and manner students respond to questions in ecology in the final year examinations, hence this affects the total marks in Biology examination questions (WAEC, 2019 & 2020). In fact, this is attributed to inappropriate instructional strategies employed by Biology

teachers, inability to engaged students to learn through hands-on activities, students' attitude towards biology and insufficient instructional materials among others (Saladin, Jibrin & Mohammed (2020); Hussaini, Mohammed & Jibrin, 2020).

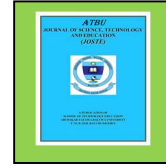
On the basis of this, Essien and Aniefiok (2019) opined that if Biology teachers would employ instructional strategies that would involves students in carrying out hands-on activities, may enhance students' academic performance in Biological concepts. One of these strategies that may enhance students' learning and understanding through hands-on activities include Project-Based Learning (Wekesa & Ongunya (2016). Project-Based Learning (PBL) is a strategy by which instructions is shifted from teacher-centred approach to students-centred where the learners are provided with some learning materials and tasks whose output is usually a concrete product (Ayan, 2012). The PBL is grounded in constructivists learning theory where active learning is emphasized among learners. The constructivist learning theory support this present study because the biology students would be actively involved in the learning of ecological concepts. And as such, learners would always gain some learning experiences as they interact with one another to construct new knowledge, where it makes the classroom an active learning environment (Yilmaz & Nihal, 2013; Jibrin, 2014; Okoro, 2019). This according to Wekesa and Ongunya, (2016) it guide the learners to solve problems, think very well and to make rational decision. In the light of this, Wekesa and Ongunya (2016) reported that students exposed to PBL achieved higher as against those taught via the conventional lecture method, even when compared with group discussion, PBL was found to be superior.

Similarly, Karacalli and Korur (2012) reported that PBL has been very efficient in teaching electricity in physics. In the light of this, Khan., Muhammad, Ahmed, Saeed, and Aman, (2012) expressed that activity-based learning like PBL helps a lot in improving students' learning outcomes. Also, Preeti and Sunil (2017) reported that PBL was very effective in learning Biology as

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the learning process is via hands-on and minds-on activities in understanding of the natural phenomenon. This could be explain that teaching via PBL strategy makes students to understand biology better when compared to traditional learning. However, Ayan,(2012) earlier reported that significant difference does not exist between students taught with PBL and those exposed to lecture method, but then, Denis and Balim (2012) reported that group of students taught solar system with PBL performed significantly better than their counterparts taught using lecture method. It is in the light of this that, the present study investigated the Impact of Project-Based Learning Strategy on Academic Performance in Ecology among Secondary School II Biology Students within Misau Metropolis, Misau LGA of Bauchi State.

Objective of the Study

This study investigated the impact of Project-Based Learning Strategy (PBL) on SSII biology students' academic performance in ecology. Specifically, the study:

1. Determine the impact of Project-Based Learning on the academic performance of SSII Biology in ecology.

Research Question

2. What is the difference in the mean performance scores of SSII biology students taught ecology using PBL and their counterparts taught using lecture method?

Hypothesis

HO₁. There is no significant difference between the mean performance scores of SSII biology students taught ecology using PBL and their counterparts taught using lecture method.

RESEARCH METHODOLOGY

In this study, a pretest-posttest control group quasi-experimental research design was employed. The pretest served to establish the equivalence in the ability levels of the students before the commencement of the treatment, while the posttest aimed to determine the effect of the

treatment. The study population consisted of all 1421 Senior Secondary School II Biology students in Misau Metropolis, Misau Local Government Area of Bauchi state. The pretest identified three schools with the same ability level. Subsequently, two schools were randomly selected using a balloting method, and one intact class was randomly chosen from each of the selected schools, resulting in a total sample size of 91 subjects. These two schools were also randomly assigned to the experimental and control groups.

For data collection, an Ecology Performance Test (EPT) was developed by the researchers, comprising twenty-five multiple-choice questions with options from A to D. The instruments underwent content and face validation by three experts with PhD qualifications in the Science Education Department of Abubakar Tafawa Balewa University, Bauchi, as well as biology teachers at the secondary school level with a minimum of a B.Sc(Ed) qualification, given their familiarity with the Biology curriculum. The experts' observations, corrections, and suggestions were incorporated to modify the instruments. After validation, the number of items in the EPT was reduced to 20.

The reliability of the EPT was determined through a test-retest method conducted on SSII Biology students outside the study area to avoid prior familiarity with the instrument. The reliability index, calculated using the Pearson Product Moment Correlation Coefficient (PPMCC), yielded a value of $(r) = 0.73$, which is considered acceptable for a study of this nature.

Before implementing the treatment, the researchers provided two weeks of training to the regular Biology teachers from the sample schools, who would serve as research assistants. They were trained in the use of the Problem-Based Learning (PBL) approach. Following the training, research assistants received teaching packages and lesson plans for both the PBL and lecture methods. In the treatment process, the experimental group was taught using PBL activities focusing on ecological concepts, including activities such as identifying objects from pictures, creating models of food chains, food

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webs, and energy pyramids, and conducting investigations into ecosystem functions.

For the control group, the same ecological concepts were taught using the conventional lecture method, without the students constructing functional ecosystems. The teaching procedures for both groups occurred simultaneously and extended for six weeks, culminating in the administration of the posttest. The posttest was administered using the same items as the pretest, with questions reshuffled to prevent item familiarity. The EPT instructed students to choose the correct option for each question, with a 30-minute duration. The scripts were collected, marked, and scored, with one mark for correct answers and zero for incorrect responses. The total test score was twenty marks.

Data analysis involved the use of Mean and Standard Deviation to address research questions and Independent Sample t-test statistics for testing null hypotheses at a significance level of $P \leq 0.05$.

Is this conversation helpful so far?

RESULTS PRESENTATION

The data analyzed revealed the following results according to the research question raised and the null hypothesis formulated.

Research Question one: What is the difference in the mean performance scores of SSII Biology students taught ecology using PBL and their counterparts taught using lecture method?

Table 1: Posttest Mean Academic Performance Scores of Students taught Ecology using Project-Based Learning and those taught using Lecture Method

| Group | N | Mean | SD | Mean difference |
|---------|----|-------|------|-----------------|
| Expt | 46 | 26.26 | 4.67 | 8.17 |
| Control | 45 | 18.09 | 5.04 | |

The results in Table 1 indicates that the experimental group taught ecology via project-based learning strategy have a mean score of 26.26 with standard deviation of 4.67, while their counterparts taught ecological concepts using lecture method earned a mean score of 18.09 with a standard deviation of 5.04. From this, the mean difference between those in the experimental group and control group was found to be 8.17. This clearly indicated that those in the experimental group achieved better than those in

the control group, hence the research question has being answered. However, the level of the significance difference in the two mean scores were tested statistically in the corresponding hypothesis.

Hypothesis One: There is no significant difference between the mean performance scores of SSII Biology students taught ecology using PBL and their counterparts taught using traditional lecture method

Table 3: t-test Statistics of Posttest Mean Academic Performance Scores of Students taught Ecology using Project Based Learning and those taught using Lecture Method

| Group | N | Mean | SD | DF | t-cal | P-cal | Remark |
|---------|----|-------|------|----|-------|-------|--------|
| Expt | 46 | 26.26 | 4.67 | 89 | 8.02 | 0.00 | Sig. |
| Control | 45 | 18.09 | 5.04 | | | | |

Sig, at 0.05 level

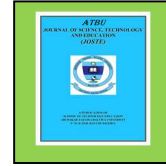
The results in Table 4 revealed the mean scores of 26.26 for students exposed to

Project Based Learning and 18.09 for their counterparts taught using conventional lecture

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method respectively at $P= 0.00$ at the DF of 89. Since 0.00 is less than 0.05 level of significance, it means that there is a significant difference in the mean performance scores of students exposed to Project Based Learning and those taught using the conventional lecture method. Therefore, the hypothesis which states that there is no significant difference between the mean score of SSII biology students taught ecological concepts using PBL and their counterparts taught using traditional lecture method is rejected. This could be that the students in the experimental group participated in carrying out some hands-on activities, while those in control group were not given the opportunity to carry out any hands-on activity as the ecological concepts were taught without been engaged but remain as passive listeners.

DISCUSSION OF FINDINGS

The study investigating the impact of Project-Based Learning on biology students' performance and their attitudes toward ecology yielded significant findings. It was evident that biology students who were exposed to Project-Based Learning outperformed their peers taught through the conventional lecture method. This discovery aligns with prior research by Yimaz and Nihal (2013), who found that engaging students in activity-based learning, such as Project-Based learning, enhances their learning experiences and performance in science. Additionally, Wekesa and Ogunya's study in 2016 demonstrated that Project-Based learning led to improved performance in the classification of living organisms. Similarly, Olatoye and Adekoya's research in 2010 indicated that PBL had a positive impact on students' performance in Agricultural science. Furthermore, studies by David (2018) and Jibrin, Mohammed, and Zayum (2020) affirmed that students' engagement in hands-on activities enriched their science learning experiences and had a beneficial effect on their academic performance in biology. These findings suggest that the methods employed by teachers in their classroom instruction significantly influence students' performance (Nazif, Shehu & Musa, 2019).

On the other hand, in a contrasting study, Ayan (2012) reported that there was no significant difference between students exposed to Project-Based Learning and those taught using the conventional lecture method in science subjects. This highlights the need for further exploration and the consideration of various factors that may influence the effectiveness of Project-Based Learning in different educational contexts.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are made;

1. **Promote the Integration of Project-Based Learning:** Educational institutions should encourage the incorporation of Project-Based Learning into the biology curriculum. This approach can be highly effective in enhancing students' understanding of ecological concepts and improving their academic performance. Teachers should receive training and support in implementing Project-Based Learning effectively, ensuring that it aligns with curriculum objectives and promotes active student engagement.
2. **Foster a Diverse Instructional Environment:** While Project-Based Learning showed significant benefits, it is important to recognize that different students may respond differently to various instructional methods. Therefore, educators should maintain a diverse range of teaching approaches, including both traditional lectures and hands-on activities, to accommodate various learning styles. This approach ensures that all students have the opportunity to excel in biology and develop positive attitudes toward ecology.
3. **Further Research and Assessment:** Educational institutions should continue to conduct research to explore the impact of Project-Based Learning on different aspects of science education.

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This includes assessing the long-term effects on students' retention of ecological knowledge and their application of this knowledge beyond the classroom. Continuous assessment will help refine teaching methodologies and provide evidence-based insights into the most effective strategies for improving biology education.

CONCLUSION

The conclusions drawn from the results of this study underscore the critical influence of students' learning experiences on their performance in Biology. It is evident that the nature of the teaching and learning process plays a pivotal role in shaping students' academic achievements. Specifically, when students are actively engaged in a child-centered approach that immerses them in hands-on learning activities, such as the implementation of Project-Based learning, there is a notable enhancement in their performance, particularly in their understanding and application of ecological concepts. This suggests that an interactive and experiential approach to biology education can significantly improve students' outcomes, fostering a deeper and more enduring comprehension of ecology and its principles. As such, educators and institutions should prioritize the integration of active and inquiry-based learning strategies to empower students and optimize their educational journeys in the realm of biology.

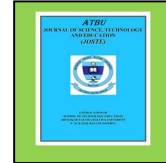
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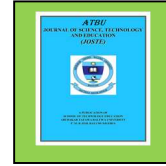


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